NON-PUBLIC?: N
ACCESSION #: 9101160184
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Washington Nuclear Plant - Unit 2 PAGE: 1 OF 7

DOCKET NUMBER: 05000397

TITLE: Reactor Scram Due to Main Generator Trip Caused by Shorted Main Transformer Output Line Insulator-Less Than Adequate Corrective Action Plan/Plant Design
EVENT DATE: 12/07/90 LER #: 90-031-00 REPORT DATE: 01/07/91

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS:

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

On December 7, 1990 at 1010 hours, a reactor scram occurred due to actuation of the Reactor Protection System (RPS) logic. The initiating scram signal was "turbine governor valve fast closure" due to a Main Turbine/Generator trip with reactor power greater than 30 percent. The logic was actuated when the Main Generator 500 KV output breakers tripped as a result of high currents created when a procelain insulator in the Transformer Yard shorted to ground. The insulator is on the ouput side of 25/500 KV Main Transformer TR-M2 B" Phase). The electrical fault (flashover) was due to Circulating Water (CW) System Cooling Tower water chemical deposits having built up on the insulator, with wet and icing conditions contributing to provide a conductive path over the surface of the insulator.

At 1019 hours, an "Unusual Event" was declared as directed by the

Emergency Classification procedure due to the resulting fault caused explosion within the Protected Area (Transformer Yard). At 1030 hours, the reactor scram was reset and, at 1100 hours, the "Unusual Event" was terminated.

The root causes of this event were: 1) a less than adequate corrective action plan pertaining to the schedule and scope for inspecting and cleaning the 500 KV insulators, and 2) a less than adequate Plant design in that the Transformer Yard is situated in a prevailing, high-speed wind pattern location that results in the insulators being vulnerable to chemical drift deposition.

END OF ABSTRACT

Immediate corrective actions consisted of replacing the damaged insulator stack; inspecting and cleaning all other 500 KV, 230 KV, and 115 KV insulators in the Main Transformer Yard; sampling the oil in all three Main Transformers for gas concentration; and performing diagnostic tests on transformer TR-M2. Further corrective actions consist of modifying the Preventive Maintenance Program for insulator monitoring; performing an Engineering evaluation to determine the need for design changes or enhancements to the Transformer Yard or insulators; and reducing both the number of Circulating Water chemical cycles of concentration and the concentration of a corrosion inhibitor in the water.

This event posed no threat to the health and safety of either the public or plant personnel.

Plant Conditions

Power Level - 100%
Plant Mode - 1 (Power Operation)

Event Description

On December 7, 1990 at 1010 hours, a reactor scram occurred due to actuation of the Reactor Protection System (RPS) logic. The initiating scram signal was "turbine governor valve fast closure" due to a Main Turbine/Generator trip with reactor power greater than 30 percent. The logic was actuated when the Main Generator 500 KV output breakers tripped as a result of high currents created when a procelain insulator in the Transformer Yard shorted to ground. The insulator is on the ouput side of 25/500 KV Main Transformer TR-M2 ("B" Phase). The electrical fault (flashover) was due to Circulating Water (CW) System Cooling Tower water

chemical deposits having built up on the insulator, with wet and icing conditions contributing to provide a conductive path over the surface of the insulator.

Emergency Diesel Generators DG-1 and DG-2 immediately started on an undervoltage signal, as designed, but did not tie onto the bus because the undervoltage condition was not of sufficient duration to complete the time-delay logic.

Following the scram, at 1015 hours, the Reactor High Water Level trip setpoint (Level 8: +54.5 inches) was reached due to the design of Reactor Feedwater Control System response capability. The Level 8 trip occurred despite the Reactor Feedwater Level Control automatic setpoint design feature to control vessel level, and subsequent Plant Operator efforts to manually ramp down feedwater flow.
owever, as discussed further in this
LER, response to a full load reject is not within the design capability of the Reactor Feedwater Level Control setpoint setdown feature. The Level 8 actuation caused Reactor Feedwater Pumps RFW-P-1A and RFW-P-1B to trip. Reactor Feedwater Pump RFW-P-1A was immediately re-started to maintain Reactor Vessel water level. This level transient was moderate and was controlled by Plant Operators without difficulty. Furthermore, there was no significant impact on scram recovery efforts due to the level transient.

At 1019 hours, an "Unusual Event"was declared as directed by the Emergency Classification procedure due to the resulting fault-caused explosion within the Protected Area (Transformer Yard). At 1030 hours, the reactor scram was reset and the emergency diesel generators were secured. At 1100 hours, the "Unusual Event" was terminated.

Immediate Corrective Action

1. Plant Operators responded in a timely manner to maneuver the Plant to a safe shutdown condition in accordance with Operational procedures.

2. The damaged insulator stack was replaced and all other 500 KV, 230 KV and 115 KV insulators in the Main Transformer Yard were inspected and cleaned. The oil in all three Main Transformers was sampled for gas concentration and the results were within normal limits. Diagnostic tests were also performed on TR-M2, the transformer that took the direct fault current. The fault was determined to be mild from the oscillograph printout of the event, and the results of the

testing showed no changes in power factor, turn-to-turn ration or impedance. Following the successful testing efforts, the transformers were declared operable.

Further Evaluation and Corrective Action

A. Further Evaluation

1. This event is reportable under 10CFR50.73(a)(2)(iv) as an event or condition that resulted in manual or automatic actuation of any Engineered Safety Feature (ESF), including the Reactor Protective System (RPS).

2. There were no structures, systems or components that were inoperable at the start of the event that contributed to the event. At the time of the event, High Pressure Core Spray (HPCS) Diesel Generator HPCS-DG-3 was in operation as part of the monthly HPCS Diesel Generator operability test. Under these test conditions, HPCS-DG-3 was in a full-load status and parallelled to the 230 KV off-site power source (Transformer TR-S). As a result of the fault-initiated fast transfer of Plant loads onto Transformer TR-S, the Plant distribution system experienced a slight reduction in voltage. This voltage difference resulted in an increased VAR loading for HPCS-DG-3. The additional current was of a sufficient amount to actuate the time overcurrent protection feature which is designed to protect HPCS-DG-3 from faults in the non-Class 1E portion of the distribution system. Actuation of the time overcurrent protection, by design, resulted in the tripping of the preferred source circuit breaker (HPCS-BKR-4-2) to Critical Bus SM-4 approximately 80 seconds into the event. At this point the HPCS Diesel Generator continued to operate, supplying only the normal loads on SM-4 by design. The unit was later parallelled and the normal loads transferred to Transformer TR-S. At 1100 hours, HPCS-DG-3 was secured.

3. The causes of this event are as follows:

a) Less Than Adequate Corrective Action Plan, pertaining to the schedule and scope for inspecting and cleaning the 500 KV insulators, which resulted in a non-conservative Preventive Maintenance Program. A previous LER (89-002) documented an identical event that occurred due to a neutral ground overcurrent condition, caused by insulator

failure, on 25/500 KV "A" Phase Main Transformer TR-M1. The evaluation of that event concluded that the immediate cause of the 500 KV insulator failure was a buildup of film on the outside surface of the insulator. The conductive film was comprised mostly of calcium, silicon and sulfer, with appropriate amounts of oxygen to make up the oxide. The film was composed of chemical residue deposited by vapor from the Circulating Water System cooling towers. The major constituents of the residue were river water minerals, and sulfate compounds from sulfuric acid that is used to control the pH of the circulating water.

Corrective actions for the previous event were to 1) implement a formal preventive maintenance program for the insulators, and 2) perform an Engineering evaluation of line and post insulators to determine the need for design changes.

Although a preventive maintenance program was developed and implemented, the specified frequency for the cleaning of the 500 KV insulators was apparently less than adequate. The cleaning schedule for the insulators and bushings in the transformer yard was set to be on one-year intervals, with a provision for winter cleaning. The winter cleaning provision was, if a forced outage should occur during the winter, the condition of the insulators would be visually assessed and cleaned as necessary. At the time, it was believed that the risk of another insulator failure was low because the first insulator failure had occurred after several years of deposition of chemicals, and a continuous 200-day run which went through the winter months last year. However, there was no plan in place to take the Plant off-line to support an insulator inspection or cleaning during the winter months. The synergistic effects of insulator base contamination, fog and freezing conditions are now known to be primary factors in causing an insulator flashover condition. The 500 KV insulators were last cleaned in May, 1990 during the annual maintenance and refueling outage.

It was concluded from the previous Engineering study that no insulator design enhancements could be made which would eliminate the need for cleaning under the existing conditions in the transformer yard.

b. Less Than Adequate Plant Design in that the Transformer Yard is situated in a prevailing, high-speed wind pattern location that results in the insulators being vulnerable to chemical drift deposition from Circulating Water System Cooling Tower vapor. As a result of the previous event (LER 89-002), a Cooling Tower Drift Study was performed. Although the results of the study are still being analyzed, preliminary data indicate a significant increase of chemical deposition in the Transformer Yard during the November to January time-frame, relative to the rest of the year. Further meteorological data compiled over the last five years also indicate that, during August through December 1990, the frequency of high speed (greater than 24 mph) winds from the south-southwest direction exceeded the total from the last five years combined. Winds of that speed and direction would force the Cooling Tower vapor drift into the area of the Transformer Yard.

4. During the event Main Steam Relief Valve MS-RV-1B automatically opened when its trip setpoint of 1076 psig was reached. The relief valve closed within its pressure switch relief tolerance. The maximum pressure reached during the event was 1079 pisg. The voltage transient associated with the Main Generator trip also caused the Standby Service Water System to start by design to provide cooling for the operating Emergency Diesel Generators.

5. During the scram followup review process, it was noted that the Control Rod Block computer point, driven from Control Rod Drive (CRD) Level Switch CRD-LS-13E which is mounted on the "B" Scram Discharge Volume (SDV), showed as being "RESET" approximately four minutes prior to the scram switches resetting. The scram switches are set at approximately two feet higher than the rod block switches and, as a result, the scram switches should have reset first on decreasing SDV water level. Accordingly, a troubleshooting plan was developed and implemented as an attempt to re-create the problem and determine the possible cause. During testing this problem could not be re-created and the system and switches functioned as designed with the scram switches resetting before the rod blocks.

6. Although the Reactor Feedwater Level Control response was not as expected to prevent the Level 8 trip, the system performed as designed with respect to the automatic setpoint setdown

design feature. This feature worked properly; however, setpoint setdown is designed to control vessel level following a scram from the nuclear side of the Plant and not a full load reject (Balance of Plant trip).

B. Further Corrective Action

1. The Preventive Maintenance Program for insulator monitoring will be modified to provide objective criteria for action based on the conductive condition of the insulators and meteorological conditions, relative to flashover value.

2. A followup Engineering evaluation will be performed to determine the need for design changes or enhancements to the Transformer Yard insulators.

3. As an attempt to possibly reduce the contamination rate of the insulators, the number of Circulating Water chemical cycles of concentration has been reduced from twelve to five. In addition, the concentration of a corrosion inhibitor in the water has been reduced. These actions will be periodically evaluated to determine the effectiveness and benefit of continued operation with regard to Circulating Water quality and insulator contamination.

4. An evaluation is currently in progress to research industry actions for either preventing or mitigating the potential for insulator failures such as described in this event.

5. An evaluation is currently in progress to consider the feasibility of modifying the Reactor Feedwater Level Control System to provide better response during events such as a full load rejection.

6. Although t
e Control Rod Drive Scram Discharge Volume level switch problem could not be re-created during troubleshooting efforts, a followup evaluation is being performed as a further attempt to discover the cause.

SAFETY SIGNIFICANCE

There is no safety significance associated with this event. The Reactor Protection System functioned as designed to automatically initiate a

reactor scram in response to an actual Turbine Control Valve Fast Closure. The Plant response to this transient was also as expected. The Reactor Vessel High Level 8 condition did not significantly impact the response to the scram or pose any safety concern. Accordingly, this event posed no threat to the health and safety of either the public or Plant personnel.

SIMILAR EVENTS

LER 89-002, "Turbine Control Valve Fast Closure Reactor Scram due to Main Generator Caused by Equipment Failure - Shorted Main Transformer Output Line Insulator."

EIIS INFORMATION

Text Reference EIIS Reference
System Component

Reactor Protection system (RPS) JC --
Turbine Control Valve TA XCV
Main Turbine TA TRB
Main Generator TB GEN
500KV Output Breakers TB 52
500KV Insulators TB INS
Main Transformer TR-M2 TB XFMR
Emergency Diesel Generators DG-1 and DG-2 EK GEN
Reactor Feedwater System JB --
RFW-P-1A JB P
RFW-P-1B JB P
115KV Insulators TB INS
230 KV Insulators TB INS
High Pressure Core Spray (HPCS) BG ---
HPCS-DG-3 EK GEN
Transformer TR-S EA XFMR
HPCS-BKR-4-2 EK BKR
Critical Bus SM-4 EA BU
Main Transformer TR-Ml TB XFMR
Circulating Water (CW) System NN ---
CW Cooling Towers NN TWR
MS-RV-1B SB RV
Standby Service Water System BI ---
CRD-LS-12E AA LS
Scram Discharge Volume (SDV) AA TK

WASHINGTON PUBLIC POWER SUPPLY SYSTEM
P.O. Box 968 3000 George Washington Way Richland, Washington 99352

Docket No. 50-397

January 7, 1991

Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Subject: NUCLEAR PLANT NO. 2
LICENSEE EVENT REPORT NO. 90-031

Dear Sir:

Transmitted herewith is Licensee Event Report No. 90-031 for the WNP-2 Plant. This report is submitted in response to the report requirements of 10CFR50.73 and discusses the items of reportability, corrective action taken, and action taken to preclude recurrence.

Very truly yours,

J. W. Baker (M/D 927M)
WNP-2 Plant Manager

JWB:lr

Enclosure:
Licensee Event Report No. 90-031

cc: Mr. John B. Martin, NRC - Region V
Mr. C. Sorensen, NRC Resident Inspector (M/D 901A)
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